U.S. Department
of Transportation

Federal Aviation Administration

Memorandum

Subject: **ACTION**: Request for Review and Concurrence with an Equivalent Level of Safety (ELOS) ACE-04-02, to 14 CFR part 23, §23.1061 Liquid Cooling -- Installation and 23.1063 Liquid Cooling -- Coolant tank tests for the Thielert Supplemental Type Certificate to Install Thielert TAE-125-01 Diesel Engines in Certain Cessna 172 Series Airplanes.

Date: July 27, 2004

From: Cessna Program Manager, ACE-117W

Reply to Attn. of: Todd Dixon (816) 329-4146

To: Manager, Small Airplane Directorate, ACE-100

This memorandum documents concurrence for the subject finding of Equivalent Level of Safety (ELOS). We request your office to review and concur with the proposed ELOS finding to 14 CFR part 23, §14 CFR part 23, §23.1061(b) Liquid Cooling -- Installation. The proposed ELOS will allow for the utilization of a coolant tank that has a capacity less than that required by §23.1061(b).

Background: The airplanes that the Supplemental Type Certificate (STC) will apply to are the Cessna 172K, L, M, N, P, R and S. These are conventional airplanes currently powered by gasoline engines that are air-cooled. The Thielert engine requires a liquid cooling system be installed; however, the system does not have the capacity mandated by §23.1061(b). The applicant has requested, by submission of type design data and materials through the Luftfahrt-Bundesamt (LBA) of Germany, an ELOS for the provisions of 14 CFR part 23, §23.1061(b) Liquid Cooling -- Installation at Amendment 51.

The FAA has researched the origins of §23.1061(b) with respect to the coolant tank volume requirements. The coolant tank volume requirements date from at least 1945; and have been unchanged since then. The types of liquid coolant systems in service at that time were systems utilized on lowered powered gasoline engines, neither the type of engines or the type of system that the requirement was applicable to was envisioned when the requirement originated.

Because of this, the FAA believes that despite the prescriptive nature of this regulation, its basis in five-decade-old technology compels the FAA to review the need for the requirement. In reviewing the Thielert coolant system, the FAA has determined that the relevant goal is maintaining the operability of the engine. While not complying with the prescriptive requirements of §23.1061(b), the

Thielert cooling system demonstrated appropriate engine cooling capability, including expected cases of coolant loss.

Applicable Regulations: The applicable regulation is 14 CFR part 23, §23.1061(b) which states:

> *§23.1061 Installation.*
>
> .....
>
> *(b) Coolant tank. The tank capacity must be at least one gallon, plus 10 percent of the cooling system capacity.*
>
> .....

Compensating Features:

The Thielert TAE-125 reciprocating diesel engine uses a closed loop liquid cooling system with an expansion tank for engine cooling. In normal operation, such a system does not have a loss of cooling fluid, with the expansion tank ensuring a proper fluid level with various temperature and pressure situations. This type of cooling system is state of the art in automobile liquid cooling systems and has been tested for functionality; otherwise it complies with all provisions of the applicable airworthiness standards; and the only deviation from the regulations being the volume of the tank.

To ensure an ELOS to the general intent of §23.1061(b) for a safety margin in case of coolant fluid loss, the following was required by the Luftfahrt Bundesamt (LBA) of the Thielert STC design:

• The expansion tank capacity was shown to be large enough to ensure safe operation of the cooling system in case of cooling fluid loss that could be expected in service. This was demonstrated by analysis and tests. The minimum and maximum fluid levels were established.

• It was demonstrated that the reduced thermal buffer capacity of the TAE 125 cooling tank does not affect the safe operation and the emergency capability adversely. This was shown for both heating up and cooling down. The cooling capacity of the system was shown to be able to compensate for the reduced thermal buffer capacity.

• The expansion tank must be able to withstand the vibration, inertia and fluid loads to which it may be subjected in operation, as required in §23.1063.

The same provisions will constitute the FAA equivalent level of safety.

Recommendation: We concur that the substantiation of the functionality of a coolant tank size smaller than mandated by regulation provides an ELOS to that intended by §23.1061(b), and recommend the issuance of this ELOS.

Concurred by:

William J. Timberlake	*7/21/04*
Manager, Project Support Branch, ACE-112	Date
Scott Sedgwick	*7/21/04*
Manager, Standards Office, ACE-110	Date
Dorenda D. Baker	*7/27/04*
Manager, Small Airplane Directorate, ACE-100	Date